STATE OF MISSOURI
Matt Blunt, Governor • Doyle Childers, Director
DEPARTMENT OF NATURAL RESOURCES
www.dnr.mo.gov

APR 03 2007

Wisdom Home, LLC
P.O. Box 238
Merriam Woods, MO 65740

Dear Applicant:

Enclosed please find construction permit number SWRO-1828 for Vista Ridge Subdivision sewer extension in the Village of Merriam Woods, Taney County, Missouri. This permit authorizes the construction of the facilities described in the application and permit and is issued in accordance with the regulations of the Missouri Clean Water Commission. Revised engineering plans and/or specifications must be submitted prior to making any changes for the work described in the permit.

The enclosed loading sheet indicates the facility has adequate capacity to serve the proposed sewer extension. As the facility approaches the 80% capacity level the City should begin its planning for the expansion of the wastewater treatment facility. The Department of Natural Resources administers the State Revolving Fund which can assist the City in funding the needed upgrades to the system.

The department's review has been limited to the impact of the extension on the treatment capacity of the local wastewater facility. It is the responsibility of your consulting engineer to ensure that the design and construction conforms with all required engineering standards, state and local regulations. Department staff may conduct random, on-site inspections of some construction projects to further ensure conformity with the requirements.

This permit will expire one year from the date of issuance unless justification for extension is presented thirty (30) days prior to expiration.

The enclosed permit applies only to the construction of water pollution control components; it does not apply to other environmentally regulated areas. The enclosed permit is invalid for projects required to comply with the requirements contained in 10 CSR 20-Chapter 4, "Grants".

In addition to the requirements for a construction permit, land disturbance activities of one (1) or more acres requires a Missouri State Operating Permit to discharge stormwater (10 CSR 20-6.200). This permit requires best management practices sufficient to control runoff and sedimentation in order to protect waters of the state. For more information or to obtain the proper forms, please contact the Department of Natural Resources, Southwest Regional Office by calling 417-891-4300.

Verification of compliance with 10 CSR 20-8.120, Design of Sewers; Sections (6)(G)5, Deflection Test; (6)(H)2, Leakage Test, when required by rule (required on all pressure sewers); and (11) Protection of Water Supplies will be required before authorization will be granted to place the facilities to be constructed under this construction permit into service. See the enclosed permit conditions.

Missouri Clean Water Commission Regulations 10 CSR 20-6.010(5)(D) and 10 CSR 20-6.010(6)(B) require that the engineer certify that the construction has been completed in accordance with the approved plans and specifications and requires that the owner or continuing authority apply for a Letter of Authorization. The enclosed Application for Letter of Authorization shall be completed by both the engineer and the owner / continuing authority and returned to the Southwest Regional Office. A copy of the consulting engineer's field notes must accompany the application.

If you were affected by this decision, you may appeal to have the matter heard by the administrative hearing commission. To appeal, you must file a petition with the administrative hearing commission within thirty days after the date this decision was mailed or the date it was delivered, whichever date was earlier. If any such petition is sent by registered mail or certified mail, it will be deemed filed on the date it is mailed; if it is sent by any method other than registered mail or certified mail, it will be deemed filed on the date it is received by the administrative hearing commission.

If you have questions please contact Mr. Joshua L. Grosvenor, E.I., by calling 417-891-4300 or via mail at Southwest Regional Office, 2040 W. Woodland, Springfield, Missouri 65807-5912.

Sincerely,

SOUTHWEST REGIONAL OFFICE

Cynthia S. Davies
Regional Director

CSD/jgh

Enclosures

c: City of Rockaway Beach
Mr. Michael E. Stalzer, P.E., MESA Consulting Engineers
Village of Merriam Woods

TANEY / WPC
ROCKAWAY BEACH REGIONAL – CP
VISTA RIDGE SUBDIVISION

Construction Permit SWRO-1828

STATE OF MISSOURI
DEPARTMENT OF NATURAL RESOURCES
MISSOURI CLEAN WATER COMMISSION

CONSTRUCTION PERMIT

The Missouri Department of Natural Resources hereby issues a permit to:

Wisdom Home, LLC
P.O. Box 238
Merriam Woods, MO 65740

for the construction of (described facilities):

(SEE ATTACHED FACILITY DESCRIPTION)

Permit Conditions:

(SEE ATTACHED PERMIT CONDITIONS)

Construction of such proposed facilities shall be in accordance with the provisions of the Missouri Clean Water Law, Chapter 644, RSMo, and regulation promulgated thereunder, or this permit may be revoked by the Department of Natural Resources.

As the Department of Natural Resources does not examine structural features of design or the efficiency of mechanical equipment, the issuance of this permit does not include approval of these features.

A representative of the department may inspect the work covered by this permit during construction. Issuance of a permit to operate by the department will be contingent on the work substantially adhering to the approved plans and specifications.

This permit applies only to the construction of water pollution control components; it does not apply to other environmentally regulated areas.

April 3, 2007
Effective Date

Doyle Childers, Director, Department of Natural Resources
Executive Secretary, Clean Water Commission

April 2, 2008
Expiration Date

Cynthia S. Davies, Regional Director, Southwest Regional Office

FACILITY DESCRIPTION:

Project includes wastewater collection facilities designed in accordance with MCWC Regulation 10 CSR 20-8.110 through 8.500 which are applicable to facilities that have or are part of larger facilities that have a design average day flow greater than 22,500 gallons per day.

These facilities will serve 69 single family lots located in NE ¼, NW ¼, Sec. 11, T24N, R21W, Taney County, Missouri.

The design average day flow is estimated to be 17,000 gallons per day, or 708.3 gallons per hour, or 11.81 gallons per minute containing an estimated 28.9 pounds per day of five-day biochemical oxygen demand (BOD_5). The organic population equivalent is estimated to be 170 based on 0.17 LB BOD_5 / person / day. The hydraulic population equivalent is estimated to be 170 based on 100 gallons / person / day. The design peak day flow to design average day flow ratio based on MCWC Regulation 10 CSR 20-8.120(5)(B) is estimated to be:

$$\frac{18 + \left[\frac{\text{(hydraulic population equivalent)}}{(1{,}000)}\right]^{0.5}}{4 + \left[\frac{\text{(hydraulic population equivalent)}}{(1{,}000)}\right]^{0.5}} = \frac{18.4123}{4.4123} = 4.173$$

The design peak day flow is estimated to be (4.173) (17,000) = 70,940 gallons per day, 2,956 gallons per hour, or 49.27 gallons per minute.

The design average day raw wastewater organic strength is

$$\left[\frac{28.9 \text{ LB } BOD_5/\text{day}}{17{,}000 \text{ gallon / day}}\right]\left[\frac{\text{gallon}}{3.785\text{L}}\right]\left[\frac{453590 \text{ mg } BOD_5}{\text{LB } BOD_5}\right] = 203.7 \text{ mg } BOD_5 / \text{L}$$

Brief Wastewater Collection Facility Description

STANDARD TECHNOLOGY COMPONENTS

Note that standard technology includes components designed in accordance with Missouri Clean Water Commission (MCWC) Regulation 10 CSR 20-8.110 through 8.500 as well as components not included in the regulations, but which meet Southwest Regional Office (SWRO) design guidance. The design guidance components are allowed as new technology under MCWC Regulation 10 CSR 20-8.140(5)(B). The limited department engineering review, which is the basis for this permit was focused only on sizing major components, which are listed in this section.

Note that the minimum sizes or capacities listed as requirements for these major components do not include any safety factor applied by the design engineer or additional capacity provided by the design engineer for future growth. The limited department engineering review did not include review of construction requirements for major components other than sizing and did not include review of required minor components. However, these are still mandatory and are listed in detail in a later section of this permit. It is the design engineer's responsibility to ensure the design meets these requirements.

(A) Grinder Pump Stations

(1) Actual design includes one (1) pump in each grinder pump station for a total of 68 grinder pump stations, each pump with a minimum capacity of 10 gpm at 135 feet total dynamic head (tdh) with a 70 gallon wet well at each service connection or pair of service connections.

(2) Minimum regulatory/design guidance requirement is a single pump with a 50 gallon minimum volume wet well at each service connection or pair of service connections.

(B) Sewer Force Main

Actual design includes 164 linear feet of one-and-one-half-inch (1 ½") nominal diameter sewer force main, 1,505 linear feet of two-inch (2") nominal diameter sewer force main, 1,184 linear feet of three-inch (3") nominal diameter sewer force main.

NON-STANDARD TECHNOLOGY COMPONENTS

Note the responsibility for non-standard technology rests solely with the design engineer. Non-standard technology is allowed as new technology under Missouri Clean Water Commission (MCWC) Regulation 10 CSR 20-8.140(5)(B). A schedule of compliance to assess the effectiveness of the non-standard technology will be included in the Missouri State Operating Permit (MSOP). The use of non-standard technology may have a significant degree of risk.

(A) None

Wastewater will be received by the Rockaway Beach Regional wastewater treatment facility.

Construction requirements for standard technology major components listed in the brief wastewater collection facility description are included in this section and are mandatory. Minor components, which are required but not listed in the brief wastewater collection facility description are included in this section and are mandatory. Generic construction requirements for many types of components (bedding depth, bedding material requirements, separation from water main requirements, etc.) are listed in this section and are mandatory.

Standard technology construction requirements for missing components or non-standard technology components that would otherwise be considered standard technology except that regulatory requirements or Southwest Regional Office (SWRO) design guidance requirements were not met are also listed in this section for information purposes but these requirements are not necessarily applicable.

(A) Grinder Pump Stations

Grinder pump capacity and total dynamic head (tdh) shall be designed in conjunction with each force main segment to provide a minimum of two feet per second (2fps) velocity with the most probable number of pumps in operation. If no data is available outlining the most probable number of pumps in operation simultaneously, the following default may be used:

No. of Pumps Connected	No. of Pumps On	No. of Pumps Connected	No. of Pumps On
1	1	114-146	9
2-3	2	147-179	10
4-9	3	180-212	11
10-18	4	213-245	12
19-30	5	246-278	13
31-50	6	279-311	14
51-80	7	312-344	15
81-113	8		

In addition to elevation difference, the total dynamic head (tdh) calculation shall include friction loss, which shall be calculated using the Hazen-Williams formula with a coefficient of 120 for PVC (and similar pipe) or a coefficient of 100 for ductile iron (and similar pipe). The Hazen-Williams formula is:

$$f = 0.2083 \left(\frac{100}{C}\right)^{1.852} \frac{Q^{1.852}}{di^{4.8655}}$$

Where: f is friction loss as feet of water per 100 feet of pipe length
C is Hazen-Williams coefficient = 120 for PVC
= 100 steel/ductile iron
Q is flow rate as gallons per minute
di is average inside diameter as inches

Note that the total dynamic head (tdh) must also be sufficient to overcome the maximum force main elevation (if different from the force main termination elevation) during unsteady state (start-up) conditions. Also note that minor friction losses for ells, tees, wyes, valves, check valves, and other appurtenances must be included as equivalent pipe length or otherwise calculated to obtain a completely accurate tdh.

Pipe dimensions and Hazen-Williams formula for ASTM D 2241 SDR-21 PVC pipe are given below:

ASTM D 2241 SDR-21 Pipe					
Nominal Pipe Size (inches)	Average Outside Diameter (inches)	Wall Thickness Minimum (inches)	Wall Thickness Tolerance (inches)	Average Inside Diameter (inches)	Hazen-Williams Formula for C=120 and SCR-21 Average inside diameter
1	1.315	0.063	+0.020	1.169	$f=0.069517Q^{1.852}$
1 ¼	1.660	0.079	+0.020	1.482	$f=0.021917Q^{1.852}$
1 ½	1.900	0.090	+0.020	1.700	$f=0.011241Q^{1.852}$
2	2.375	0.113	+0.020	2.129	$f=0.0037610Q^{1.852}$
2 ½	2.875	0.137	+0.020	2.581	$f=0.0014740Q^{1.852}$
3	3.500	0.167	+0.020	3.146	$f=0.00056260Q^{1.852}$
3 ½	4.000	0.190	+0.023	3.597	$f=0.00029317Q^{1.852}$
4	4.500	0.214	+0.026	4.046	$f=0.00016541Q^{1.852}$
5	5.563	0.265	+0.032	5.001	$f=0.000058991Q^{1.852}$
6	6.625	0.316	+0.038	5.955	$f=0.000025226Q^{1.852}$
8	8.625	0.410	+0.049	7.756	$f=0.0000069745Q^{1.852}$
10	10.750	0.511	+0.061	9.667	$f=0.0000023884Q^{1.852}$
12	12.750	0.606	+0.073	11.465	$f=0.00000104151Q^{1.852}$
14	14.000	0.666	+0.080	12.588	$f=0.00000066101Q^{1.852}$
16	16.000	0.762	+0.091	14.358	$f=0.00000034533Q^{1.852}$
18	18.000	0.857	+0.103	16.183	$f=0.00000019470Q^{1.852}$
20	20.000	0.952	+0.114	17.982	$f=0.00000011658Q^{1.852}$
24	24.000	1.143	+0.137	21.577	$f=0.000000048030Q^{1.852}$
30	30.000	1.428	+0.171	26.973	$f=0.000000016213Q^{1.852}$
36	36.000	1.714	+0.205	32.367	$f=0.0000000066779Q^{1.852}$

All electrical components, electrical wiring, controls, control wiring, alarms, and alarm wiring shall meet the National Electric Code for hazardous locations. An audio/visual alarm shall be provided at each grinder pump station. A gate valve (or other shutoff valve) shall be provided on each grinder pump station discharge line located near the force main. Valves that are buried shall be fitted with a valve box and riser to the ground surface to allow operation. Minimum grinder pumping station wet well volume shall be 50 gallons.

(B) Sewer Force Main

The sewer force main shall have thickness and strength equal to or greater than that of ASTM D 2241 SDR-21. The sewer force main shall have a minimum cover depth over the pipe of 30 inches.

A velocity equal to or greater than the 2.000 feet per second (2 fps) regulatory minimum shall be maintained when the minimum number of pumps that will operate simultaneously are in operation. For ASTM D 2241 SDR-21 PVC pipe with an average inside diameter equal to the average outside diameter – 2 (minimum thickness + ½ pipe thickness tolerance), the minimum flow rate to achieve 2.000 feet per second (2 fps) velocity is 6.691 gallons per minute for one-inch (1") nominal diameter pipe, 10.75 gpm for one-and-one-fourth inch (1 ¼"), 14.15 gpm for one-and-one-half inch (1 ½"), 22.19 gpm for two-inch (2"), 32.62 gpm for two-and-one-half inch (2 ½"), 48.46 gpm for three-inch (3"), 63.35 gpm for three-and-one-half inch (3 ½"), 80.15 gpm for four-inch (4"), 122.4 gpm for five-inch (5"), 173.6 gpm for six-inch (6"), 294.5 gpm for eight-inch (8"), 457.6 gpm for ten-inch (10"), 643.6 gpm for 12-inch, 775.8 gpm for 14-inch, 1,013 gpm for 16-inch, 1,282 gpm for 18-inch, 1,583 gpm for 20-inch, 2,280 gpm for 24-inch, 3,562 gpm for 30-inch, and 5,129 gpm for 36-inch nominal diameter pipe.

The sewer force main shall be constructed to be sufficiently water tight to meet an exfiltration (leakage) rate less than or equal to 200 gallons per inch diameter per mile of pipe length per day and shall be tested under the supervision of a professional engineer registered in the state of Missouri to demonstrate that this maximum leakage rate is met. This combined pressure and leakage test shall have the following elements: testing to be done after concrete thrust blocks have cured for at least 36 hours and after all back filling is complete; test duration shall be equal to or greater than one (1) hour; test pressure shall be equal to or greater than 50-psig; pipes shall be filled slowly and purged of all air; the quantity of water pumped into the system during the test period in order to maintain pressure within five (5) psig of the test pressure is the leakage. Other leakage test methods including AWWA C605 Section 7 or ASTM F 1417 may be used at the discretion of the professional engineer.

The sewer force main shall have poured concrete thrust blocks bearing against undisturbed earth (or mechanical restraints) at each ell, wye, tee, and other changes of direction and shall have air relief valves at all local high points.

Embedment for the sewer force main shall extend from four inches (4") below the sewer force main (from six inches (6") below the sewer force main in rock) to six inches (6") above the sewer force main.

Embedment for the sewer force main in ordinary trench conditions shall be crushed stone, crushed gravel, crushed rock, or sand with 100% passing a one inch (1") (25 mm) sieve.

High strength embedment for the sewer force main (steel reinforced concrete low cradle, steel reinforced concrete high cradle, steel reinforced concrete encasement, or steel reinforced concrete arch) constructed to ASTM C 12 (standards for Class A embedment) shall be used for problem soil conditions, near Karst features including caves and sink holes, for road crossings, for stream crossings, for water main / sewer force main crossings, and for sewer force main / stormwater crossings.

Sewer force main and drinking water lines shall be laid so that there is not permanent physical connection between a potable water supply and any sewer, sewage treatment device or appurtenance; shall be laid so that no drinking water line passes through or has any contact with any part of a sewer manhole; shall be laid in parallel with a horizontal separation equal to or greater than ten feet (10') with the distance between the sewer force main and drinking water line measured edge to edge; or shall be laid in parallel with a horizontal separation less than ten feet (10') with the sewer force main and the drinking water line being in separate trenches with the drinking water line located above the sewer force main with a minimum vertical separation of 18 inches (18") measured from the bottom of the drinking water line to the top of the sewer force main; or shall be laid in parallel in the same trench with the drinking water line being on an undisturbed earth shelf above the sewer force main with a minimum vertical separation of 18 inches (18") measured from the bottom of the drinking water line to the top of the sewer line; shall be laid at crossings with a minimum vertical separation of 18 inches (18") measured from the outside of the sewer force main to the outside of the drinking water line regardless of which line is above the other line with sewer force main joints and the drinking water line joints being equidistant and as far as possible from each other.

STATE OF MISSOURI
Matt Blunt, Governor • Doyle Childers, Director
DEPARTMENT OF NATURAL RESOURCES
www.dnr.mo.gov

APR 1 1 2007

Tri-Sons Properties, LLC
P.O. Box 1200
Hollister, MO 65673

Dear Applicant:

Enclosed please find construction permit number SWRO-1839 for Cedarwood Subdivision Lots 4 & 5, Block 73 sewer extension in the Village of Merriam Woods, Taney County, Missouri. This permit authorizes the construction of the facilities described in the application and permit and is issued in accordance with the regulations of the Missouri Clean Water Commission. Revised engineering plans and/or specifications must be submitted prior to making any changes for the work described in the permit.

The enclosed loading sheet indicates the facility has adequate capacity to serve the proposed sewer extension. As the facility approaches the 80% capacity level the City should begin its planning for the expansion of the wastewater treatment facility. The Department of Natural Resources administers the State Revolving Fund which can assist the City in funding the needed upgrades to the system.

More information about the State Revolving Fund may be found in the following links:
http://www.dnr.mo.gov/env/wpp/srf/cwsrf-compar.pdf
http://www.dnr.mo.gov/env/wpp/srf/cwsrf-info.htm

The department's review has been limited to the impact of the extension on the treatment capacity of the local wastewater facility. It is the responsibility of your consulting engineer to ensure that the design and construction conforms with all required engineering standards, state and local regulations. Department staff may conduct random, on-site inspections of some construction projects to further ensure conformity with the requirements.

This permit will expire one year from the date of issuance unless justification for extension is presented thirty (30) days prior to expiration.

The enclosed permit applies only to the construction of water pollution control components; it does not apply to other environmentally regulated areas. The enclosed permit is invalid for projects required to comply with the requirements contained in 10 CSR 20-Chapter 4, "Grants".

In addition to the requirements for a construction permit, land disturbance activities of one (1) or more acres requires a Missouri State Operating Permit to discharge stormwater (10 CSR 20-6.200). This permit requires best management practices sufficient to control runoff and sedimentation in order to protect waters of the state. For more information or to obtain the proper forms, please contact the Department of Natural Resources, Southwest Regional Office by calling 417-891-4300.

Verification of compliance with 10 CSR 20-8.120, Design of Sewers; Sections (6)(G)5, Deflection Test; (6)(H)2, Leakage Test, when required by rule (required on all pressure sewers); and (11) Protection of Water Supplies will be required before authorization will be granted to place the facilities to be constructed under this construction permit into service. See the enclosed permit conditions.

Missouri Clean Water Commission Regulations 10 CSR 20-6.010(5)(D) and 10 CSR 20-6.010(6)(B) require that the engineer certify that the construction has been completed in accordance with the approved plans and specifications and requires that the owner or continuing authority apply for a Letter of Authorization. The enclosed Application for Letter of Authorization shall be completed by both the engineer and the owner / continuing authority and returned to the Southwest Regional Office. A copy of the consulting engineer's field notes must accompany the application.

If you were affected by this decision, you may appeal to have the matter heard by the administrative hearing commission. To appeal, you must file a petition with the administrative hearing commission within thirty days after the date this decision was mailed or the date it was delivered, whichever date was earlier. If any such petition is sent by registered mail or certified mail, it will be deemed filed on the date it is mailed; if it is sent by any method other than registered mail or certified mail, it will be deemed filed on the date it is received by the administrative hearing commission.

If you have questions please contact Mr. Joshua L. Grosvenor, E.I., by calling 417-891-4300 or via mail at Southwest Regional Office, 2040 W. Woodland, Springfield, Missouri 65807-5912.

Sincerely,

SOUTHWEST REGIONAL OFFICE

Cynthia S. Davies
Regional Director

CSD/jgh

Enclosures

c: City of Rockaway Beach
Village of Merriam Woods
Mr. Michael E. Stalzer, P.E., MESA Consulting Engineers

TANEY / WPC
ROCKAWAY BEACH, CITY OF – CP
CEDARWOOD SUBDIVISION LOTS 4 & 5, BLOCK 73

Construction Permit SWRO-1839

STATE OF MISSOURI
DEPARTMENT OF NATURAL RESOURCES
MISSOURI CLEAN WATER COMMISSION

CONSTRUCTION PERMIT

The Missouri Department of Natural Resources hereby issues a permit to:

Tri-Sons Properties, LLC
P.O. Box 1200
Hollister, MO 65673

for the construction of (described facilities):

(SEE ATTACHED FACILITY DESCRIPTION)

Permit Conditions:

(SEE ATTACHED PERMIT CONDITIONS)

Construction of such proposed facilities shall be in accordance with the provisions of the Missouri Clean Water Law, Chapter 644, RSMo, and regulation promulgated thereunder, or this permit may be revoked by the Department of Natural Resources.

As the Department of Natural Resources does not examine structural features of design or the efficiency of mechanical equipment, the issuance of this permit does not include approval of these features.

A representative of the department may inspect the work covered by this permit during construction. Issuance of a permit to operate by the department will be contingent on the work substantially adhering to the approved plans and specifications.

This permit applies only to the construction of water pollution control components; it does not apply to other environmentally regulated areas.

Doyle Childers

April 10, 2007
Effective Date

Doyle Childers, Director, Department of Natural Resources
Executive Secretary, Clean Water Commission

Cynthia S. Davies

April 9, 2008
Expiration Date

Cynthia S. Davies, Regional Director, Southwest Regional Office

FACILITY DESCRIPTION:

Project includes wastewater collection facilities designed in accordance with MCWC Regulation 10 CSR 20-8.110 through 8.500 which are applicable to facilities that have or are part of larger facilities that have a design average day flow greater than 22,500 gallons per day.

These facilities will serve two (2) single family homes, Village of Merriam Woods, located in NW ¼, SW ¼, NW ¼, Sec. 12, T24N, R21W, Taney County, Missouri.

The design average day flow is estimated to be 500 gallons per day, or 20.83 gallons per hour, or 0.3472 gallons per minute containing an estimated 0.85 pounds per day of five-day biochemical oxygen demand (BOD_5). The organic population equivalent is estimated to be 5 based on 0.17 LB BOD_5 / person / day. The hydraulic population equivalent is estimated to be 5 based on 100 gallons / person / day. The design peak day flow to design average day flow ratio based on MCWC Regulation 10 CSR 20-8.120(5)(B) is estimated to be:

$$\frac{18 + \left[\frac{\text{(hydraulic population equivalent)}}{(1{,}000)}\right]^{0.5}}{4 + \left[\frac{\text{(hydraulic population equivalent)}}{(1{,}000)}\right]^{0.5}} = \frac{18.0707}{4.0707} = 4.44$$

The design peak day flow is estimated to be (4.44) (500) = 2,220 gallons per day, 92.48 gallons per hour, or 1.54 gallons per minute.

The design average day raw wastewater organic strength is

$$\left(\frac{0.85 \text{ LB } BOD_5/\text{day}}{500 \text{ gallon / day}}\right)\left(\frac{\text{gallon}}{3.785\text{L}}\right)\left(\frac{453590 \text{ mg } BOD_5}{\text{LB } BOD_5}\right) = 203.7 \text{ mg } BOD_5 / \text{L}$$

Brief Wastewater Collection Facility Description

STANDARD TECHNOLOGY COMPONENTS

Note that standard technology includes components designed in accordance with Missouri Clean Water Commission (MCWC) Regulation 10 CSR 20-8.110 through 8.500 as well as components not included in the regulations, but which meet Southwest Regional Office (SWRO) design guidance. The design guidance components are allowed as new technology under MCWC Regulation 10 CSR 20-8.140(5)(B). The limited department engineering review, which is the basis for this permit was focused only on sizing major components, which are listed in this section.

Note that the minimum sizes or capacities listed as requirements for these major components do not include any safety factor applied by the design engineer or additional capacity provided by the design engineer for future growth.

The limited department engineering review did not include review of construction requirements for major components other than sizing and did not include review of required minor components. However, these are still mandatory and are listed in detail in a later section of this permit. It is the design engineer's responsibility to ensure the design meets these requirements.

(A) Grinder Pump Stations

(1) Actual design includes one (1) pump in each grinder pump station for a total of two (2) grinder pump stations, each pump with a minimum capacity of 5 gpm at 160 feet total dynamic head (tdh) with a 70 gallon wet well at each service connection or pair of service connections.

(2) Minimum regulatory/design guidance requirement is a single pump with a 50 gallon minimum volume wet well at each service connection or pair of service connections.

(B) Sewer Force Main

Actual design includes 105 linear feet of two-inch (2") nominal diameter class 200 PVC sewer force main.

NON-STANDARD TECHNOLOGY COMPONENTS

Note the responsibility for non-standard technology rests solely with the design engineer. Non-standard technology is allowed as new technology under Missouri Clean Water Commission (MCWC) Regulation 10 CSR 20-8.140(5)(B). A schedule of compliance to assess the effectiveness of the non-standard technology will be included in the Missouri State Operating Permit (MSOP). The use of non-standard technology may have a significant degree of risk.

(A) None

Wastewater will be received by the City of Rockaway Beach wastewater treatment facility.

Wastewater Collection Facility Construction Requirement

Construction requirements for standard technology major components listed in the brief wastewater collection facility description are included in this section and are mandatory. Minor components, which are required but not listed in the brief wastewater collection facility description are included in this section and are mandatory. Generic construction requirements for many types of components (bedding depth, bedding material requirements, separation from water main requirements, etc.) are listed in this section and are mandatory.

Standard technology construction requirements for missing components or non-standard technology components that would otherwise be considered standard technology except that regulatory requirements or Southwest Regional Office (SWRO) design guidance requirements were not met are also listed in this section for information purposes but these requirements are not necessarily applicable.

(A) Grinder Pump Stations

Grinder pump capacity and total dynamic head (tdh) shall be designed in conjunction with each force main segment to provide a minimum of two feet per second (2fps) velocity with the most probable number of pumps in operation. If no data is available outlining the most probable number of pumps in operation simultaneously, the following default may be used:

No. of Pumps Connected	No. of Pumps On	No. of Pumps Connected	No. of Pumps On
1	1	114-146	9
2-3	2	147-179	10
4-9	3	180-212	11
10-18	4	213-245	12
19-30	5	246-278	13
31-50	6	279-311	14
51-80	7	312-344	15
81-113	8		

In addition to elevation difference, the total dynamic head (tdh) calculation shall include friction loss, which shall be calculated using the Hazen-Williams formula with a coefficient of 120 for PVC (and similar pipe) or a coefficient of 100 for ductile iron (and similar pipe). The Hazen-Williams formula is:

$$f = 0.2083 \left[\frac{100}{C}\right]^{1.852} \frac{Q^{1.852}}{di^{4.8655}}$$

Where: f is friction loss as feet of water per 100 feet of pipe length
C is Hazen-Williams coefficient = 120 for PVC
= 100 steel/ductile iron
Q is flow rate as gallons per minute
di is average inside diameter as inches

Note that the total dynamic head (tdh) must also be sufficient to overcome the maximum force main elevation (if different from the force main termination elevation) during unsteady state (start-up) conditions. Also note that minor friction losses for ells, tees, wyes, valves, check valves, and other appurtenances must be included as equivalent pipe length or otherwise calculated to obtain a completely accurate tdh.

- Pipe dimensions and Hazen-Williams formula for ASTM D 2241 SDR-21 PVC pipe are given below:

ASTM D 2241 SDR-21 Pipe					
Nominal Pipe Size (inches)	Average Outside Diameter (inches)	Wall Thickness Minimum (inches)	Wall Thickness Tolerance (inches)	Average Inside Diameter (inches)	Hazen-Williams Formula for C=120 and SCR-21 Average inside diameter
1	1.315	0.063	+0.020	1.169	$f=0.069517Q^{1.852}$
1 ¼	1.660	0.079	+0.020	1.482	$f=0.021917Q^{1.852}$
1 ½	1.900	0.090	+0.020	1.700	$f=0.011241Q^{1.852}$
2	2.375	0.113	+0.020	2.129	$f=0.0037610Q^{1.852}$
2 ½	2.875	0.137	+0.020	2.581	$f=0.0014740Q^{1.852}$
3	3.500	0.167	+0.020	3.146	$f=0.00056260Q^{1.852}$
3 ½	4.000	0.190	+0.023	3.597	$f=0.00029317Q^{1.852}$
4	4.500	0.214	+0.026	4.046	$f=0.00016541Q^{1.852}$
5	5.563	0.265	+0.032	5.001	$f=0.000058991Q^{1.852}$
6	6.625	0.316	+0.038	5.955	$f=0.000025226Q^{1.852}$
8	8.625	0.410	+0.049	7.756	$f=0.0000069745Q^{1.852}$
10	10.750	0.511	+0.061	9.667	$f=0.0000023884Q^{1.852}$
12	12.750	0.606	+0.073	11.465	$f=0.00000104151Q^{1.852}$
14	14.000	0.666	+0.080	12.588	$f=0.00000066101Q^{1.852}$
16	16.000	0.762	+0.091	14.358	$f=0.00000034533Q^{1.852}$
18	18.000	0.857	+0.103	16.183	$f=0.00000019470Q^{1.852}$
20	20.000	0.952	+0.114	17.982	$f=0.00000011658Q^{1.852}$
24	24.000	1.143	+0.137	21.577	$f=0.000000048030Q^{1.852}$
30	30.000	1.428	+0.171	26.973	$f=0.000000016213Q^{1.852}$
36	36.000	1.714	+0.205	32.367	$f=0.0000000066779Q^{1.852}$

All electrical components, electrical wiring, controls, control wiring, alarms, and alarm wiring shall meet the National Electric Code for hazardous locations. An audio/visual alarm shall be provided at each grinder pump station. A gate valve (or other shutoff valve) shall be provided on each grinder pump station discharge line located near the force main. Valves that are buried shall be fitted with a valve box and riser to the ground surface to allow operation. Minimum grinder pumping station wet well volume shall be 50 gallons.

(B) Sewer Force Main

The sewer force main shall have thickness and strength equal to or greater than that of ASTM D 2241 SDR-21. The sewer force main shall have a minimum cover depth over the pipe of 30 inches.

A velocity equal to or greater than the 2.000 feet per second (2 fps) regulatory minimum shall be maintained when the minimum number of pumps that will operate simultaneously are in operation. For ASTM D 2241 SDR-21 PVC pipe with an average inside diameter equal to the average outside diameter – 2 (minimum thickness + ½ pipe thickness tolerance),

the minimum flow rate to achieve 2.000 feet per second (2 fps) velocity is 6.691 gallons per minute for one-inch (1") nominal diameter pipe, 10.75 gpm for one-and-one-fourth inch (1 ¼"), 14.15 gpm for one-and-one-half inch (1 ½"), 22.19 gpm for two-inch (2"), 32.62 gpm for two-and-one-half inch (2 ½"), 48.46 gpm for three-inch (3"), 63.35 gpm for three-and-one-half inch (3 ½"), 80.15 gpm for four-inch (4"), 122.4 gpm for five-inch (5"), 173.6 gpm for six-inch (6"), 294.5 gpm for eight-inch (8"), 457.6 gpm for ten-inch (10"), 643.6 gpm for 12-inch, 775.8 gpm for 14-inch, 1,013 gpm for 16-inch, 1,282 gpm for 18-inch, 1,583 gpm for 20-inch, 2,280 gpm for 24-inch, 3,562 gpm for 30-inch, and 5,129 gpm for 36-inch nominal diameter pipe.

The sewer force main shall be constructed to be sufficiently water tight to meet an exfiltration (leakage) rate less than or equal to 200 gallons per inch diameter per mile of pipe length per day and shall be tested under the supervision of a professional engineer registered in the state of Missouri to demonstrate that this maximum leakage rate is met. This combined pressure and leakage test shall have the following elements: testing to be done after concrete thrust blocks have cured for at least 36 hours and after all back filling is complete; test duration shall be equal to or greater than one (1) hour; test pressure shall be equal to or greater than 50-psig; pipes shall be filled slowly and purged of all air; the quantity of water pumped into the system during the test period in order to maintain pressure within five (5) psig of the test pressure is the leakage. Other leakage test methods including AWWA C605 Section 7 or ASTM F 1417 may be used at the discretion of the professional engineer.

The sewer force main shall have poured concrete thrust blocks bearing against undisturbed earth (or mechanical restraints) at each ell, wye, tee, and other changes of direction and shall have air relief valves at all local high points.

Embedment for the sewer force main shall extend from four inches (4") below the sewer force main (from six inches (6") below the sewer force main in rock) to six inches (6") above the sewer force main.

Embedment for the sewer force main in ordinary trench conditions shall be crushed stone, crushed gravel, crushed rock, or sand with 100% passing a one inch (1") (25 mm) sieve.

High strength embedment for the sewer force main (steel reinforced concrete low cradle, steel reinforced concrete high cradle, steel reinforced concrete encasement, or steel reinforced concrete arch) constructed to ASTM C 12 (standards for Class A embedment) shall be used for problem soil conditions, near Karst features including caves and sink holes, for road crossings, for stream crossings, for water main / sewer force main crossings, and for sewer force main / stormwater crossings.

Sewer force main and drinking water lines shall be laid so that there is not permanent physical connection between a potable water supply and any sewer, sewage treatment device or appurtenance; shall be laid so that no drinking water line passes through or has any contact with any part of a sewer manhole; shall be laid in parallel with a horizontal separation equal to or greater than ten feet (10') with the distance between the sewer force main and drinking water line measured edge to edge;

or shall be laid in parallel with a horizontal separation less than ten feet (10') with the sewer force main and the drinking water line being in separate trenches with the drinking water line located above the sewer force main with a minimum vertical separation of 18 inches (18") measured from the bottom of the drinking water line to the top of the sewer force main; or shall be laid in parallel in the same trench with the drinking water line being on an undisturbed earth shelf above the sewer force main with a minimum vertical separation of 18 inches (18") measured from the bottom of the drinking water line to the top of the sewer line; shall be laid at crossings with a minimum vertical separation of 18 inches (18") measured from the outside of the sewer force main to the outside of the drinking water line regardless of which line is above the other line with sewer force main joints and the drinking water line joints being equidistant and as far as possible from each other.